

**ELECTRONICS****6189****TWIN TRIODE**

Five-Star Tube

★★★★★

FOR GENERAL-PURPOSE APPLICATIONS**MEDIUM-MU
9-PIN MINIATURE****SHOCK, VIBRATION RATINGS
HEATER-CYCLING RATING****SEPARATE CATHODES**

6189GE00

6189
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 Page 1
 7-64
DESCRIPTION AND RATING

The 6189 is a miniature medium-mu twin triode suitable for a wide variety of general-purpose amplifier, oscillator, and multivibrator applications.

The 6189 is a special-quality tube intended for use in critical industrial and military applications in which operational dependability is of primary importance. Features of the tube include a high degree of mechanical strength and a heater-cathode construction capable of withstanding many-thousand cycles of intermittent operation. When used in on-off control applications, the tube will maintain its emission capabilities after long periods of operation under cutoff conditions.

GENERAL**ELECTRICAL**

Cathode - Coated Unipotential

Heater Characteristics and Ratings

Parallel* Series†

Heater Voltage, AC or DC . . . 6.3±0.6§ 12.6±1.3§ Volts
 Heater Current 0.3¶ 0.15# Amperes

Direct Interelectrode CapacitancesΔ

Grid to Plate: (g to p), Each Section. . . 1.5 pf
 Input: g to (h + k), Each Section . . . 1.6 pf
 Output: p to (h + k), Section 1. . . . 0.5 pf
 Output: p to (h + k), Section 2. . . . 0.4 pf

MECHANICAL

Operating Position - Any

Envelope - T-6 1/2, Glass

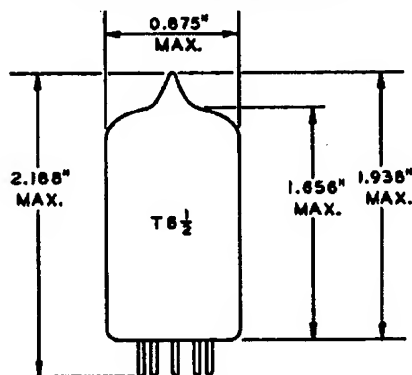
Base - E9-1, Small Button 9-Pin

Outline Drawing - EIA 6-2

Maximum Diameter. 0.875 Inches

Maximum Over-all Length . . 2.188 Inches

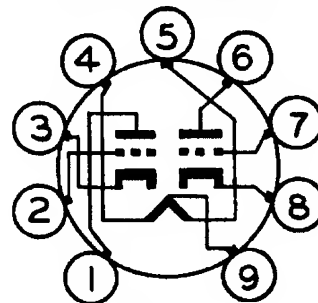
Maximum Seated Height . . . 1.938 Inches

PHYSICAL DIMENSIONS

EIA 6-2

TERMINAL CONNECTIONS

Pin 1 - Plate (Section 2)
 Pin 2 - Grid (Section 2)
 Pin 3 - Cathode (Section 2)
 Pin 4 - Heater
 Pin 5 - Heater
 Pin 6 - Plate (Section 1)
 Pin 7 - Grid (Section 1)
 Pin 8 - Cathode (Section 1)
 Pin 9 - Heater Center Tap

BASING DIAGRAM

EIA 9A

The tubes and arrangements disclosed herein may be covered by patents of General Electric Company or others. Neither the disclosure of any information herein nor the sale of tubes by General Electric Company conveys any license under patent claims covering combinations of tubes with other devices or elements. In the absence of an

express written agreement to the contrary, General Electric Company assumes no liability for patent infringement arising out of any use of the tubes with other devices or elements by any purchaser of tubes or others.

GENERAL **ELECTRIC**

MAXIMUM RATINGS

ABSOLUTE-MAXIMUM VALUES, Each Section

| | | |
|---|-----|--------------|
| DC Plate Voltage | 300 | Volts |
| Positive DC Grid Voltage | 0 | Volts |
| Negative DC Grid Voltage | 55 | Volts |
| Peak Positive Grid Voltage | 60 | Volts |
| Plate Dissipation | 3.0 | Watts |
| Grid Dissipation | 0.4 | Watts |
| DC Grid Current | 5.0 | Milliamperes |
| DC Cathode Current | 20 | Milliamperes |
| Peak Cathode Current - See Rating Chart | | |
| Heater-Cathode Voltage | | |
| Heater Positive with Respect to Cathode | 100 | Volts |
| Heater Negative with Respect to Cathode | 100 | Volts |
| Grid Circuit Resistance | | |
| With Fixed Bias | 0.5 | Megohms |
| With Cathode Bias | 1.0 | Megohms |
| Bulb Temperature at Hottest Point | 165 | C |

Absolute-Maximum ratings are limiting values of operating and environmental conditions applicable to any electron tube of a specified type as defined by its published data and should not be exceeded under the worst probable conditions.

The tube manufacturer chooses these values to provide acceptable serviceability of the tube, making no allowance for equipment variations, environmental variations, and the effects of changes in operating conditions due to variations in the characteristics of the tube under consideration and of

all other electron devices in the equipment.

The equipment manufacturer should design so that initially and throughout life no absolute-maximum value for the intended service is exceeded with any tube under the worst probable operating conditions with respect to supply-voltage variation, equipment component variation, equipment control adjustment, load variation, signal variation, environmental conditions, and variations in the characteristics of the tube under consideration and of all other electron devices in the equipment.

CHARACTERISTICS AND TYPICAL OPERATION

AVERAGE CHARACTERISTICS, Each Section

| | | |
|--|------|--------------|
| Plate Voltage | 250 | Volts |
| Grid Voltage | -8.5 | Volts |
| Amplification Factor | 17 | |
| Plate Resistance, approximate | 7700 | Ohms |
| Transconductance | 2200 | Micromhos |
| Plate Current | 10.5 | Milliamperes |
| Grid Voltage, approximate | | |
| I _b = 10 Microamperes | -24 | Volts |

NOTES

- * Operated with the two sections of the heater connected in parallel.
- ‡ Operated with the two sections of the heater connected in series.
- § The equipment designer should design the equipment so that heater voltage is centered at the specified bogey value, with heater supply variations restricted to maintain heater voltage within the specified tolerance.
- ¶ Heater current of a bogey tube at E_f = 6.3 volts.
- # Heater current of a bogey tube at E_f = 12.6 volts.
- Δ Without external shield.

CLASS A RESISTANCE-COUPLED AMPLIFIER

| EACH SECTION | | | | | | | | | | | |
|--------------|------------|-------------|----------------|------|----|-----------------|------|----|-----------------|------|----|
| Rp Meg. | Rg Meg. | Rg1 Meg. | Ebb = 90 Volts | | | Ebb = 190 Volts | | | Ebb = 300 Volts | | |
| | | | Rk | Gain | EO | Rk | Gain | EO | Rk | Gain | EO |
| 0.10 | 0.10 | 0.10 | 3600 | 10 | 10 | 3600 | 11 | 20 | 3500 | 11 | 30 |
| 0.10 | 0.24 | 0.10 | 5000 | 11 | 14 | 4700 | 12 | 27 | 4400 | 12 | 41 |
| 0.24 | 0.24 | 0.10 | 9400 | 11 | 13 | 8700 | 11 | 25 | 8700 | 12 | 38 |
| 0.24 | 0.51 | 0.10 | 11000 | 11 | 17 | 11000 | 12 | 32 | 11000 | 12 | 48 |
| 0.51 | 0.51 | 0.10 | 19000 | 11 | 15 | 18000 | 12 | 29 | 18000 | 12 | 43 |
| 0.51 | 1.0 | 0.10 | 24000 | 11 | 19 | 23000 | 12 | 37 | 23000 | 12 | 54 |
| 0.24 | 0.24 | 10 | 0 | 14 | 12 | 0 | 16 | 20 | 0 | 17 | 28 |
| 0.24 | 0.51 | 10 | 0 | 14 | 16 | 0 | 16 | 28 | 0 | 17 | 40 |
| 0.51 | 0.51 | 10 | 0 | 14 | 15 | 0 | 15 | 26 | 0 | 16 | 38 |
| 0.51 | 1.0 | 10 | 0 | 14 | 19 | 0 | 16 | 35 | 0 | 16 | 52 |

Note: Coupling capacitors (C) should be selected to give desired frequency response. Rk should be adequately by-passed.

Notes: 1. Eo is maximum RMS voltage output for five percent (5%) total harmonic distortion. 2. Gain measured at 2.0 volts RMS output. 3. For zero-bias data, generator impedance is negligible.

CHARACTERISTICS LIMITS

| | Minimum | Bogey | Maximum | |
|---|---------|-------|---------|-------------------|
| Heater Current | | | | |
| Ef = 12.6 volts. | Initial | 138 | 150 | 162 Milliamperes |
| | 500-Hr | 138 | --- | 164 Milliamperes |
| | 1000-Hr | 138 | --- | 166 Milliamperes |
| Plate Current, Each Section | | | | |
| Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts. | Initial | 6.5 | 10.5 | 14.5 Milliamperes |
| Plate Current Difference between Sections | | | | |
| Difference between plate currents for each section at Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts. | Initial | --- | --- | 3.5 Milliamperes |
| Transconductance, Each Section | | | | |
| Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts. . | Initial | 1750 | 2200 | 2650 Micromhos |
| Transconductance Change with Heater Voltage, Each Section | | | | |
| Difference between transconductance measured at Ef = 12.6 volts and transconductance at Ef = 11.4 volts (other conditions the same) expressed as a percentage of transconductance at Ef = 12.6 volts. | Initial | --- | --- | 10 Percent |
| | 500-Hr | --- | --- | 10 Percent |
| | 1000-Hr | --- | --- | 15 Percent |
| Transconductance Change with Operation, Each Section | | | | |
| Difference between transconductance measured initially and after operation expressed as a percentage of the initial value | 500-Hr | --- | --- | 15 Percent |
| | 1000-Hr | --- | --- | 20 Percent |
| Average Transconductance Change with Operation | | | | |
| Average of values for "Transconductance Change with Operation, Each Section" | 500-Hr | --- | --- | 8 Percent |
| | 1000-Hr | --- | --- | 10 Percent |
| Amplification Factor, Each Section | | | | |
| Ef = 12.6 volts, Eb = 250 volts, Ec = -8.5 volts | Initial | 15.5 | 17 | 18.5 |
| Plate Current Cutoff (1), Each Section | | | | |
| Ef = 12.6 volts, Ebb = 250 volts, Ec = -30 volts, RL = 0.1 meg | Initial | --- | --- | 20 Microamperes |

CHARACTERISTICS LIMITS (Cont'd)

| | Minimum | Bogey | Maximum | |
|---|---------|-------|---------|--------------|
| Plate Current Cutoff (2), Each Section | | | | |
| Ef = 12.6 volts, Eb = 250 volts, Ec = -18 volts Initial | 5 | --- | --- | Microamperes |
| Pulse Cathode Current, Each Section | | | | |
| Ef = 12.6 volts, Eb = 250 volts, Ec = -45 volts, Rk = 1.0 ohms, egk = +55 volts, tp = 10 μsec, prr = 1000 pps, tr = 1.0 μsec, tf = 1.0 μsec Initial | 400 | --- | --- | Milliamperes |
| 500-Hr | 300 | --- | --- | Milliamperes |
| Pulse Cathode Current at Reduced Heater Voltage, Each Section | | | | |
| Ef = 11.4 volts, Eb = 250 volts, Ec = -45 volts, Rk = 1.0 ohms, egk = +55 volts, tp = 10 μsec, prr = 1000 pps, tr = 1.0 μsec, tf = 1.0 μsec Initial | 350 | --- | --- | Milliamperes |
| Interelectrode Capacitances | | | | |
| Grid to Plate: (g to p), Each Section Initial | 1.20 | 1.50 | 1.80 | Picofarads |
| Input: g to (h + k), Each Section. Initial | 1.25 | 1.60 | 1.95 | Picofarads |
| Output: p to (h + k), Section 1 Initial | 0.30 | 0.50 | 0.70 | Picofarads |
| Output: p to (h + k), Section 2 Initial | 0.20 | 0.40 | 0.60 | Picofarads |
| Measured without external shield. | | | | |
| Negative Grid Current, Each Section | | | | |
| Ef = 12.6 volts, Eb = 250 volts, Ecc = -8.5 volts, Rg = 0.5 meg Initial | 0 | --- | 0.5 | Microamperes |
| 500-Hr | 0 | --- | 0.5 | Microamperes |
| 1000-Hr | 0 | --- | 0.5 | Microamperes |
| Heater-Cathode Leakage Current, Each Section | | | | |
| Ef = 12.6 volts, Ehk = 100 volts | | | | |
| Heater Positive with Respect to Cathode. Initial | --- | --- | 7 | Microamperes |
| 500-Hr | --- | --- | 7 | Microamperes |
| 1000-Hr | --- | --- | 7 | Microamperes |
| Heater Negative with Respect to Cathode. Initial | --- | --- | 7 | Microamperes |
| 500-Hr | --- | --- | 7 | Microamperes |
| 1000-Hr | --- | --- | 7 | Microamperes |
| Interelectrode Leakage Resistance, Each Section | | | | |
| Ef = 12.6 volts. Polarity of applied d-c interelectrode voltage is such that no cathode emission results. | | | | |
| Grid to All at 100 volts DC. Initial | 1000 | --- | --- | Megohms |
| 500-Hr | 500 | --- | --- | Megohms |
| 1000-Hr | 250 | --- | --- | Megohms |
| Plate to All at 300 volts DC Initial | 1000 | --- | --- | Megohms |
| 500-Hr | 500 | --- | --- | Megohms |
| 1000-Hr | 250 | --- | --- | Megohms |
| Grid Emission Current, Each Section | | | | |
| Ef = 15.0 volts, Eb = 250 volts, Ecc = -30 volts, Rg = 0.5 meg Initial | --- | --- | 1.5 | Microamperes |
| Cathode Interface Resistance, Each Section | | | | |
| Ef = 5.7 volts (parallel heaters), Eb = 50 volts, Ec varied for Ip = 1.0 ma 500-Hr | --- | --- | 50 | Ohms |
| 1000-Hr | --- | --- | 50 | Ohms |

SPECIAL PERFORMANCE TESTS

Minimum Bogey Maximum

| | | | | |
|---|-----|-----|-----|-----------------|
| Low Frequency Vibrational Output | --- | --- | 100 | Millivolts, RMS |
| Statistical sample is subjected to vibration in each of two planes at 40 cps, with peak acceleration 10G. Tube is operated with Ef = 12.6 volts, Ebb = 250 volts, Ec = -8.5 volts, R _L = 2000 ohms, sections in parallel. | | | | |
| Swept-Frequency Vibrational Output. | --- | --- | 300 | Millivolts, RMS |
| Statistical sample is subjected to vibration, swept from 50 to 2000 cps in 4 minutes, in each of two planes, with peak acceleration 10G. Tube is operated with Ef = 12.6 volts, Ebb = 250 volts, Ec = -8.5 volts, R _L = 2000 ohms, sections in parallel. | | | | |
| Low Pressure Voltage Breakdown Test | | | | |
| Statistical sample tested for voltage breakdown at a pressure of 21 millimeters Hg, to simulate an altitude of 80000 feet. Tubes shall not give visual evidence of flashover or corona when 500 volts RMS, 60 cps, is applied between the plate pins and adjacent pins. | | | | |

DEGRADATION RATE TESTS

Fatigue

Statistical sample vibrated for a total of 96 hours, 32 hours in each of 3 planes, at a peak acceleration of 2.5 G. Frequency is 25 cps. Tubes are operated during the test with Ef = 12.6 volts (no other voltages applied). Following the test, tubes are evaluated for low-frequency vibrational output, heater-cathode leakage, grid current, and transconductance.

Shock

Statistical sample subjected to 5 impact accelerations of approximately 450 G in each of four positions. The accelerating forces are applied by the Navy-type, High Impact (flyweight) Shock Machine using a 30 hammer angle. Tubes are operated during the test with Ef = 12.6 volts, Eb = 250 volts, Ecc = -8.5 volts, Ehk = +100 volts, and Rg = 0.1 megohms. Following the test, tubes are evaluated for low-frequency vibrational output, heater-cathode leakage, grid current, and transconductance.

Stability Life Test

Statistical sample operated under the following conditions: Ef = 12.6 volts (cycled - on 1 3/4 hours, off 1/4 hour), Eb = 250 volts, Ecc = -8.5 volts, Ehk = 135 volts with heater positive with respect to cathode, Rg = 0.5 meg, and temperature = room temperature. Tubes are evaluated, following 2 hours and 20 hours of life test, for percent change in transconductance of individual tubes.

Survival Rate Life Test

Statistical sample operated under Stability Life Test conditions is evaluated for shorted and open elements and transconductance following approximately 100 hours of life test.

Intermittent Life Test

Statistical sample operated for 1000 hours under the following conditions: Ef = 12.6 volts (cycled - on 1 3/4 hours, off 1/4 hour), Eb = 250 volts, Ecc = -8.5 volts, Ehk = 135 volts with heater positive with respect to cathode, Rg = 0.5 meg, and bulb temperature = 165 C minimum. Tubes are evaluated, following 500 and 1000 hours of the life test, for shorted or open elements, heater current, transconductance, negative grid current, heater-cathode leakage, and interelectrode leakage resistance. Life test end points are given in "Characteristics Limits" section.

Cutoff Life Test

Statistical sample operated for 1000 hours under the following conditions: Ef = 12.6 volts, Eb = 250 volts, and Ec = -30 volts. Tubes are evaluated, following 500 and 1000 hours of the life test, for shorted or open elements, negative grid current, interelectrode leakage resistance, and cathode interface resistance. Life test end points are given in "Characteristics Limits" section.

DEGRADATION RATE TESTS (Cont'd)

Pulse Life Test

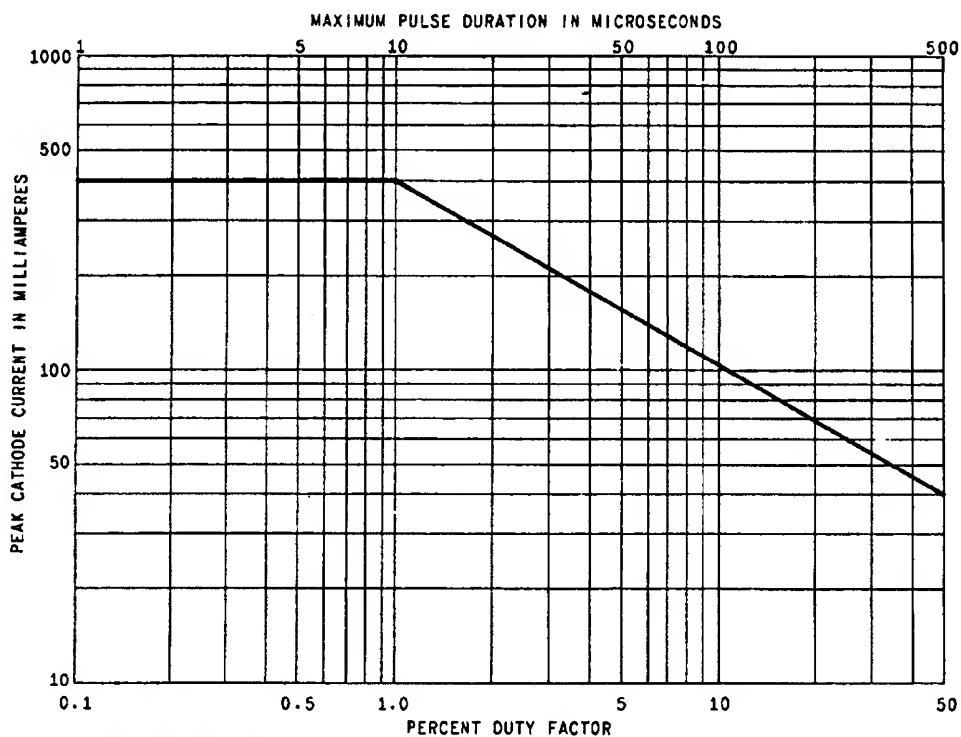
Statistical sample operated for 500 hours under the following conditions: $E_f = 12.6$ volts, $E_{bb} = 300$ volts, $E_{cc} = -40$ volts, $e_{gk} = +60$ volts, $R_p = 180$ ohms, $R_g = 47$ ohms, $t_p = 10$ μ sec, $prf = 1000$ pps, $t_r = 1.0$ μ sec, and $t_f = 1.0$ μ sec. Tubes are evaluated, following the life test, for shorted or open elements, pulse cathode current, negative grid current, and interelectrode leakage resistance. Life test end points are given in "Characteristics Limits" section.

Heater-Cycling Life Test

Statistical sample operated for 2000 cycles minimum to evaluate and control heater-cathode defects. Conditions of test include $E_f = 7.5$ volts (parallel heaters, cycled - on 1 minute, off 1 minute), $E_b = E_c = 0$ volts, and $e_{hk} = +135$ volts. Following this test, tubes are evaluated for open heaters, heater-cathode shorts, and heater-cathode leakage current.

Note: The conditions for some of the indicated tests have deliberately been selected to aggravate tube failures for test and evaluation purposes. In no sense should these conditions be interpreted as suitable circuit operating conditions.

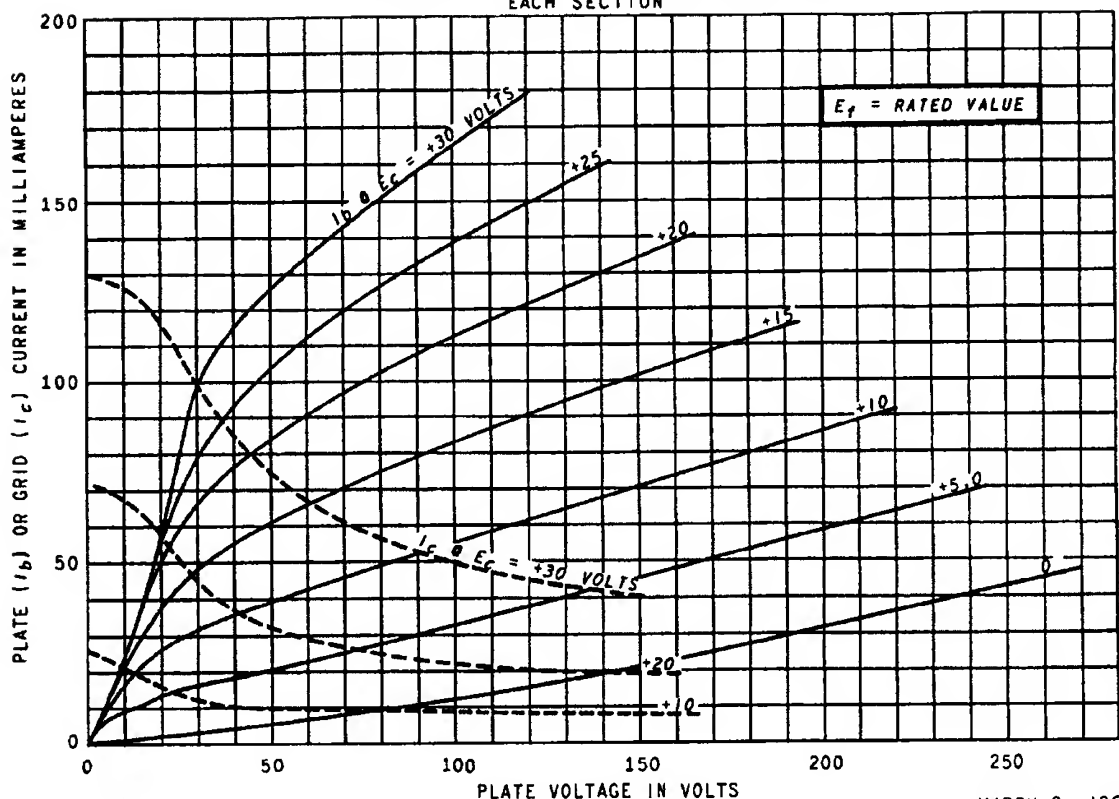
In the design of military equipment employing this tube, reference should be made to the appropriate MIL-E-1 specification.



The area below and to the left of the line establishes maximum peak cathode current per section for duty factors up to 50 percent. At duty factors greater than 50 percent, the maximum dc cathode current rating of 20 milliamperes serves to limit the peak current sufficiently. Four-hundred milliamperes is the maximum peak cathode current per section at any duty factor less than 0.1 percent. Duty factor is defined as the ratio of the average current to the maximum peak current occurring in any 1000-microsecond period.

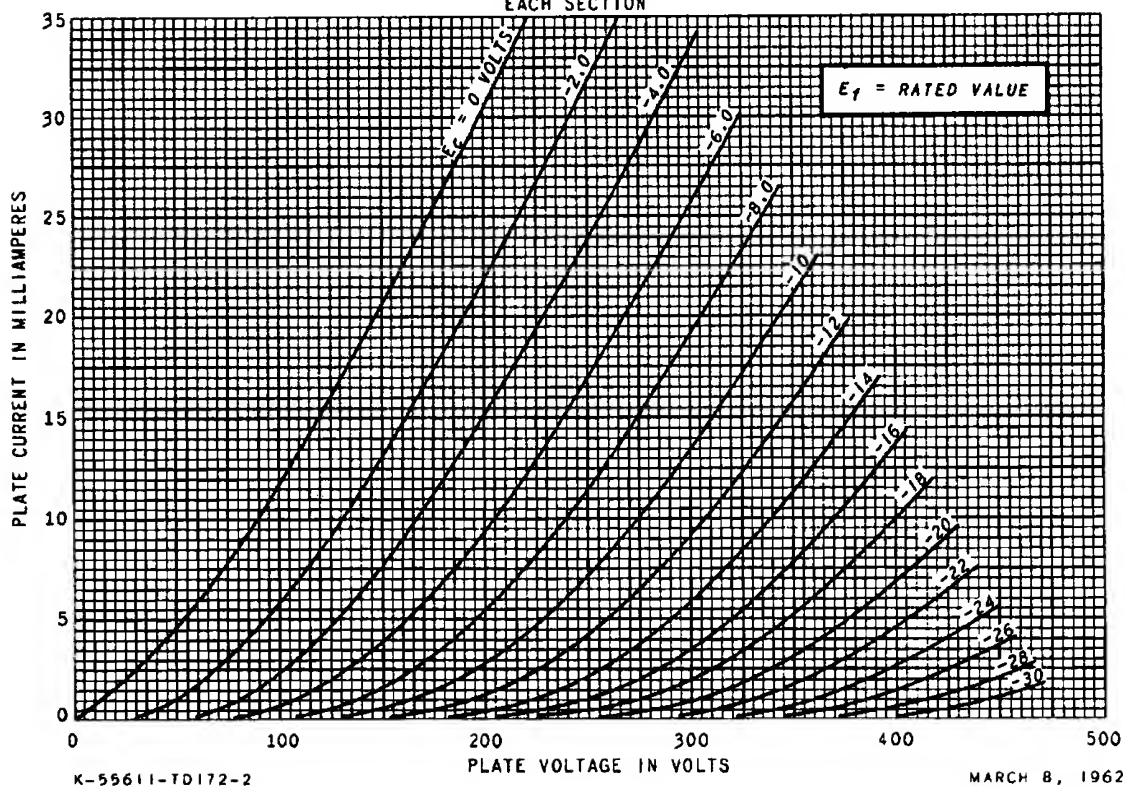
AVERAGE PLATE CHARACTERISTICS

EACH SECTION



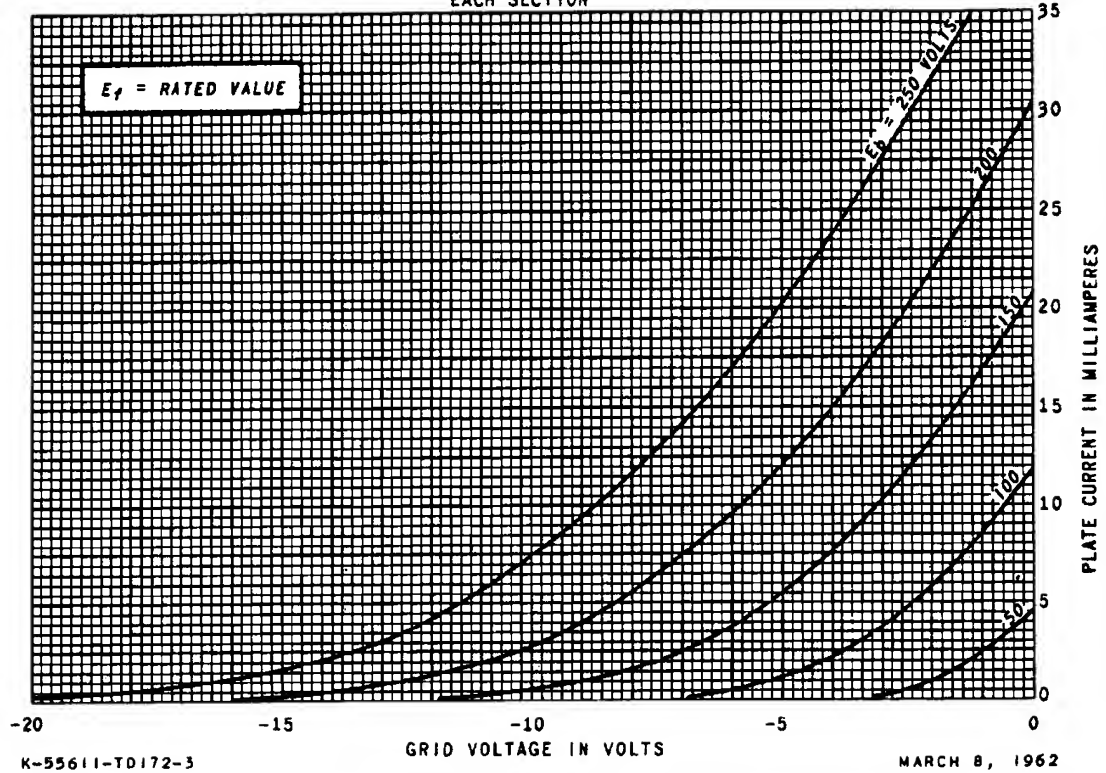
AVERAGE PLATE CHARACTERISTICS

EACH SECTION



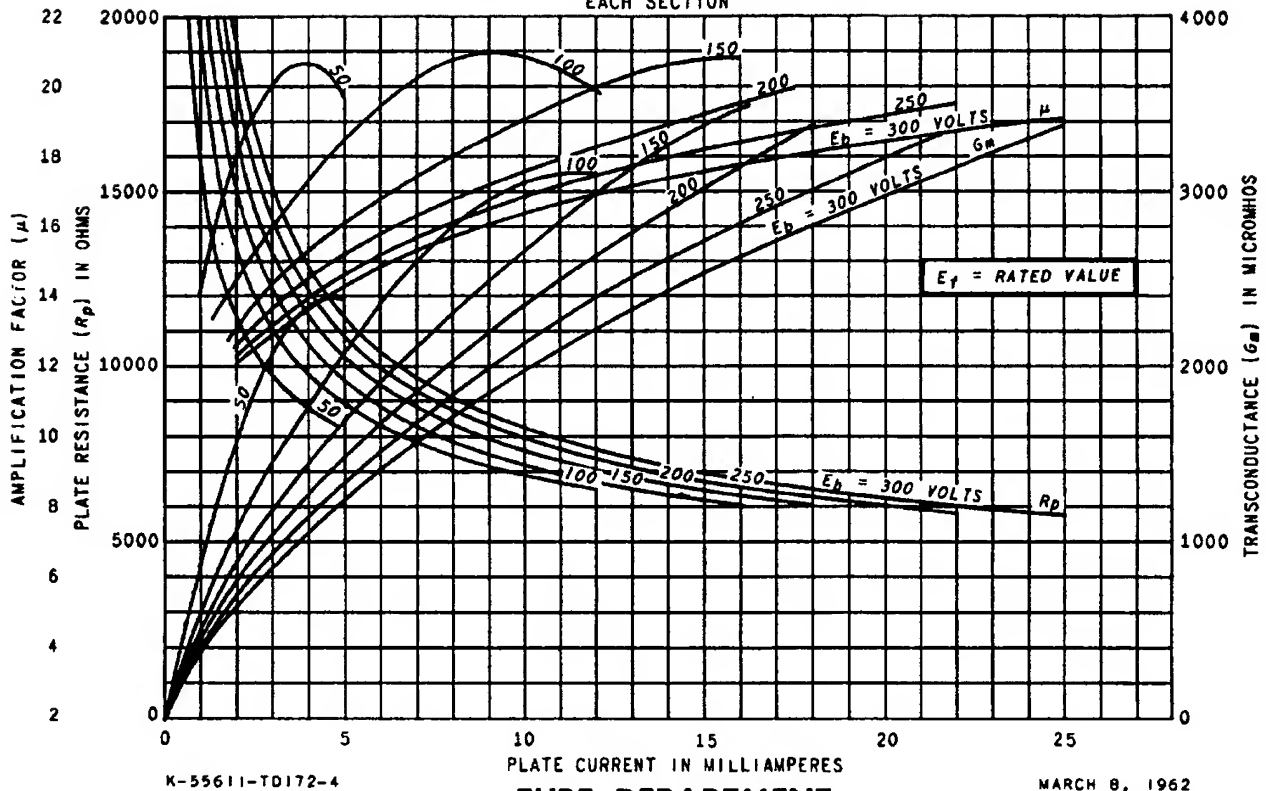
AVERAGE TRANSFER CHARACTERISTICS

EACH SECTION



AVERAGE CHARACTERISTICS

EACH SECTION



TUBE DEPARTMENT

GENERAL  ELECTRIC

Owensboro, Kentucky